CLAIMS

1.   An image processing method for estimating an output image from a plurality of input images, comprising the steps of:

5   detecting a positional relationship among the plurality of input images captured by image capture means for capturing an image each pixel of which has n pixel values; and

       estimating the output image by identifying observed
10 pixel components that should be taken into consideration from the plurality of input images for each pixel position of the output image, and producing the output image having (n + 1) or more pixel values for each pixel based on the identified observed pixel components.

15 2.   An image processing method according to claim 1, wherein in the step of estimating the output image, observed pixel components that should be taken into consideration are selected from the plurality of input images for each pixel position of the output image, and the output image having (n
20 + 1) or more pixel values for each pixel is produced based on the selected observed pixel components.

3.   An image processing method according to claim 1, wherein in the step of estimating the output image, the output image having (n + 1) or more color signals for each pixel is
25 produced from the plurality of input images, based on the

positional relationship detected in the detection step.

4. An image processing method according to claim 1, wherein in the step of estimating the output image, the output image is determined taking into account a color correlation at each pixel position and/or in the vicinity of each pixel position of the output image.

5. An image processing method according to claim 1, wherein in the step of estimating the output image, pixel values of pixels of the input images are changed to pixel values depending on the degree of steepness of an edge, and the output image is estimated based on the resultant changed pixel values.

6. An image processing method according to claim 1, wherein n is equal to 1; and

in the step of estimating the output image, the output image having three pixel values for each pixel is produced from the plurality of input images, based on the positional relationship detected in the detection step.

7. An image processing method according to claim 1, wherein the image capture means is a single-plane sensor, in which a color signal observed varies depending on the position of each input image.

8. An image processing method according to claim 1, wherein the image capture means captures the plurality of input images with underexposure; and

the image processing method further comprises the step

of correcting the exposure by gaining up each pixel value of

the plurality of input images.

9.   An image processing method according to claim 8, wherein

5   the step of estimating the output image comprises the steps

of:

determining a corrected position of each pixel

depending on the positional relationship detected in the

detection step for each pixel of each of the plurality of

10   input images;

producing a light intensity integral constraint formula

indicating that the difference between the integral of light

intensity in a region centered at the corrected position and

a pixel value of a pixel at the corrected position should be

15   less than a predetermined error; and

calculating the light intensity integral constraint

formula.

10.   An image processing method according to claim 9,

wherein when the light intensity integral constraint formula

20   is produced, if the plurality of input images have been

gained up, the error is changed depending on the factor of

the gaining up.

11.   An image processing method according to claim 8,

wherein in the step of estimating the output image,

25   a corrected position of each pixel is determined

depending on the positional relationship detected in the
detection step for each pixel of each of the plurality of
input images; and

the output image is estimated taking into account a
5   pixel value of a pixel of the input images whose corrected
position is located in the vicinity of each pixel position
of the output image and also taking into account the error
depending on the factor of the gaining up.

12.   An image processing method according to claim 1,
10   wherein in the step of estimating the output image,

a corrected position of each pixel is determined
depending on the positional relationship detected in the
detection step for each pixel of each of the plurality of
input images;

15   the output image is estimated taking into account a
pixel value of a pixel of the input images whose corrected
position is located in the vicinity of each pixel position
of the output image and also taking into account the
distance between the corrected position and the position of
20   the corresponding pixel of the output image.

13.   An image processing method according to claim 1,
wherein in the step of estimating the output image,

a corrected position of each pixel is determined
depending on the positional relationship detected in the
25   detection step for each pixel of each of the plurality of

input images; and

the output image is estimated taking into account a pixel value of a pixel of the input images whose corrected position is located in the vicinity of each pixel position

5   of the output image and also taking into account the error depending on the factor of the gaining up.

14.   An image processing method according to claim 1, wherein in the step of estimating the output image,

a corrected position of each pixel is determined

10   depending on the positional relationship detected in the detection step for each pixel of each of the plurality of input images; and

the output image is estimated by determining the weighted sum of pixel values of the input images whose

15   corrected position is located in the vicinity of each pixel position of the output image.

15.   An image processing method according to claim 14, wherein in the step of estimating the output image, the correct pixel value of a pixel of interest is estimated by

20   determining the weighted sum of pixel values of the input images whose corrected position is located in the vicinity of each pixel position of the output image, weights of the weighted sum being determined using a function having a lowpass-filter characteristic with respect to the distance

25   between the position of the pixel of interest in the output

image and the corrected position.

16. An image processing method according to claim 15, wherein in the step of estimating the output image, the correct pixel value of the pixel of interest is estimated by

5   selectively performing

    a first calculation process of determining the weighted sum of pixel values of the input images whose corrected position is located in the vicinity of the position of the pixel of interest; or

10   a second calculation process of determining the weighted sum of pixel values of the input images whose corrected position is located in the vicinity of the position of a pixel of the output image located adjacent to the pixel of interest.

15 17. An image processing method according to claim 16, wherein in the step of estimating the output image,

    the second calculation process is selected when the sum of weights in the first calculation process is equal or nearly equal to 0.

20 18. An image processing method according to claim 15, wherein in the step of estimating the output image, the correct pixel value of the pixel of interest is estimated by selectively performing

    a first calculation process of determining the weighted

25 sum of pixel values of the input images whose corrected

position is located in a first vicinity of the position of the pixel of interest; or

a second calculation process of determining the weighted sum of pixel values of the input images whose

5   corrected position is located in a second vicinity of the position of the pixel of interest, the second vicinity being greater than the first vicinity.

19.   An image processing method according to claim 18, wherein in the step of estimating the output image, the

10   second calculation process is selected when the sum of weights in the first calculation process is equal or nearly equal to 0.

20.   An image processing method according to claim 15, wherein in the step of estimating the output image, the

15   correct pixel value of the pixel of interest is estimated by selectively performing

a first calculation process of determining the sum of pixel values weighted by a first weighting factor of the input images whose corrected position is located in the

20   vicinity of the position of the pixel of interest; or

a second calculation process of determining the sum of pixel values weighted by a second weighting factor of the input images whose corrected position is located in the vicinity of the position of the pixel of interest.

25   21.   An image processing method according to claim 20,

wherein in the step of estimating the output image,

the second calculation process is selected when the sum of weights in the first calculation process is equal or nearly equal to 0.

5 22. An image processing method according to claim 1, wherein in the detection step,

the positional relationship among the plurality of input images is detected with reference to an input image captured at the exact or nearly exact center of a time

10 during which the plurality of input images were captured.

23. An image processing apparatus for estimating an output image from a plurality of input images, comprising:

image capture means for capturing the plurality of input images having n pixel values for each pixel;

15 detection means for detecting a positional relationship among the plurality of input images; and

means for estimating the output image by identifying observed pixel components that should be taken into consideration from the plurality of input images for each

20 pixel position of the output image, and producing the output image having (n + 1) or more pixel values for each pixel based on the identified observed pixel components.

24. A program for causing a computer to execute a process of estimating an output image from a plurality of input

25 images, the process comprising the steps of:

detecting a positional relationship among the plurality

of input images captured by image capture means for

capturing an image each pixel of which has n pixel values;

and

5   estimating the output image by identifying observed

pixel components that should be taken into consideration

from the plurality of input images for each pixel position

of the output image, and producing the output image having

$(n + 1)$ or more pixel values for each pixel based on the

10   identified observed pixel components.